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Indicator mineral abundance data for a bedrock sample from the Little River antimony occurrence, Newfoundland and Labrador

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ABSTRACT

As part of the Geological Survey of Canada's Targeted Geoscience Initiative 4 (TGI-4) Program, one bedrock sample was collected from the Little River antimony occurrence in southern Newfoundland to determine the indicator minerals that are indicative of Sb deposits. The purpose of this open file is to report the raw indicator mineral weight and abundance data for the bedrock sample collected in 2012 for this case study. The sample was processed using a combination of tabling, panning, and heavy liquids to recover potential indicator minerals. Sample location, weights of various fractions produced during sample processing, and indicator mineral grains identified are reported in this open file. Two Sb minerals were recovered from the bedrock sample, stibnite and stibiconite, as well as gold, arsenopyrite, and pyrite. This study provides preliminary insights into the physical appearance, size, and abundance of Sb-rich minerals which will help in the future identification of Sb-rich indicator minerals in unconsolidated surficial sediments.

INTRODUCTION

Several case studies have been published that document the indicator mineral signatures for gold and kimberlites in till, however, none have been published that document indicator mineral signatures of Sb mineralization. To address this knowledge gap, the Geological Survey of Canada (GSC), through its Targeted Geoscience Initiative 4 TGI-4 Program (2010-2015), initiated a study of bedrock from the Little River Sb occurrence in southern Newfoundland. The purpose of this open file is to report the indicator mineral abundance data for a mineralized bedrock sample collected in 2012.

Stibnite is common in mesothermal vein systems in low grade metamorphic rocks where it is commonly associated with elevated contents of As, Au, Hg, and W (Boyle and Jonasson, 1983; Nesbitt et al., 1989; Williams-Jones and Normand, 1997; Ashley et al., 2003). These deposits are the source of most of the antimony mined for commercial use. Stibnite and other Sb-bearing sulphides also occur in epithermal mineralized zones and geothermal systems associated with arc volcanism (Ashley et al., 2003).

Stibnite is rare in heavy mineral concentrates (HMC) of surficial sediments. The few examples where it has been recovered from stream sediments include studies around epithermal vein deposits in Alaska (Gray et al., 1991) and meosthermal vein deposits in Australia and New Zealand (Ashley et al., 2003). Stibnite has not been previously reported in stream or till HMC by the commercial laboratory Overburden Drilling Management Limited. It is rare in surficial sediments because stibnite will oxidize readily to Sb-oxides and easily breaks down in streams due to its softness and chemical instability in near neutral surface waters (Ashley et al., 2003).

LOCATION AND GEOLOGY

The Little River property is approximately 230 km west of St. John's, on the south coast of Newfoundland (Fig. 1). It is 80 km southeast of the Beaver Brook Sb Mine which, until 2013, was the only primary-producing Sb mine in Canada. The following description of the Little River property is summarized from the Mountain Lake Minerals Inc. website (http://www.mountain-lake.com/LittleRiver.html). The property includes several high-grade gold and massive antimony occurrences along a strike length of more than 21 km. Gold and

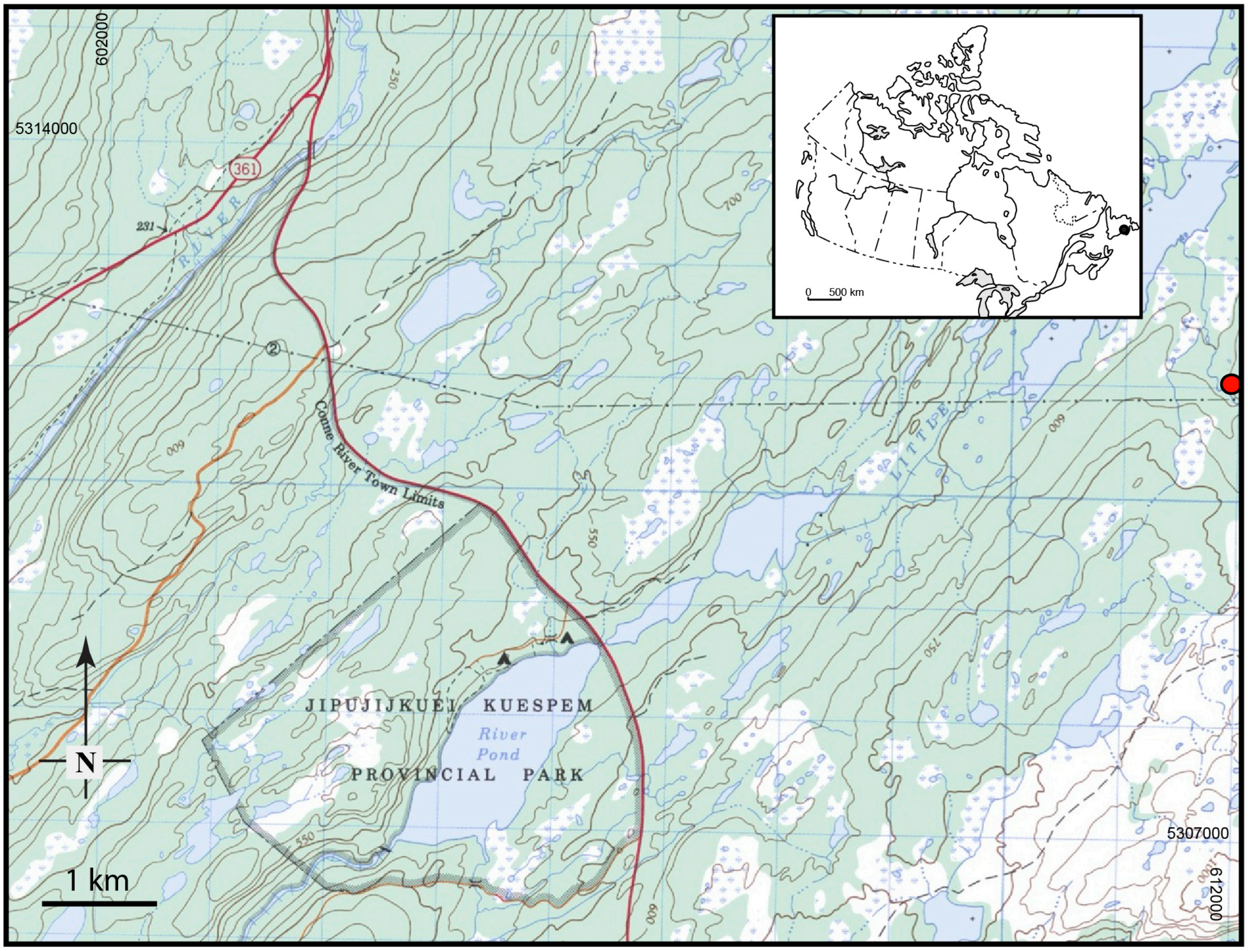

Figure 1. Location of stibnite bearing bedrock sample 12-MPB-1042 (red dot) in southern Newfoundland reported by Newfoundland and Labrador Geological Survey (2014).

stibnite occur as disseminations and as massive stibnite in quartz veins within the Little River horizon. This horizon consists of felsic to intermediate tuffs, pelites, and tuffaceous sediments. The highest grades reported are 32.7 g/t Au, and up to 6.3% Sb at the South Zone. Gangue minerals in this occurrence, reported by the Newfoundland and Labrador Geological Survey (2014), include arsenopyrite, pyrite, pyrrhotite, galena, sphalerite, and magnetite.

METHODS

A 1-kg bedrock sample was collected from a surface trench on the Little River property in southern Newfoundland (Fig. 1) by Paul Smith of Mountain Lake Minerals Inc. The bedrock sample was collected at 612159E, 5311056N (Zone 21, NAD83, NTS 01M/13) from a stibnite vein exposed for ~150 m with a maximum true surface width of 32 cm (P. Smith, pers comm., 2014). This sample was provided to GSC, where it was cut into smaller pieces for examination and processing.

A 400 g subsample (Fig. 2) was submitted to Overburden Drilling Management Limited (ODM), Ottawa, ON for processing and production of a heavy mineral concentrate. The unmodified reports prepared by ODM are reported in **Appendixes A1** and **A2**. The bedrock sample was processed using the procedures outlined in the flow chart depicted in Figure 3. It was first

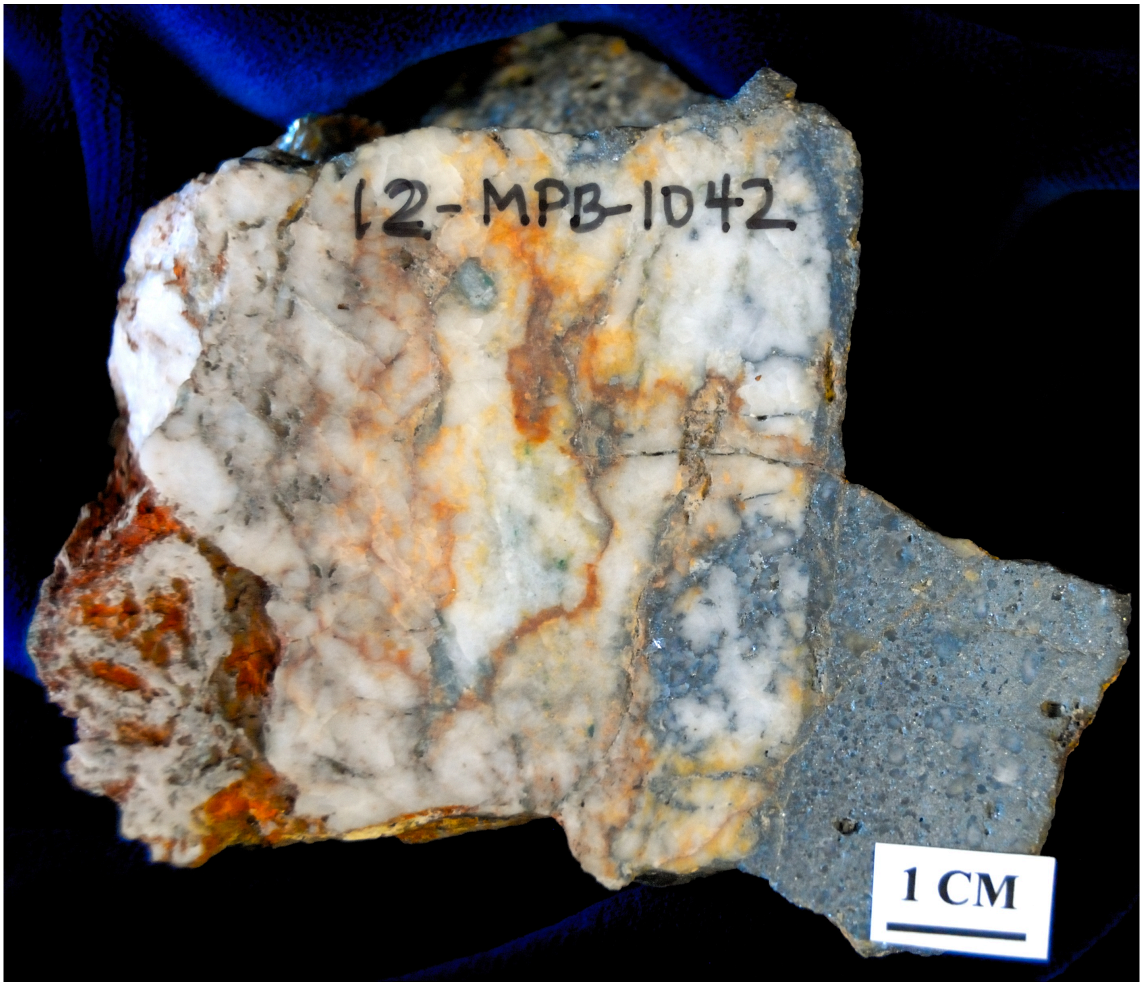

Figure 2. Polished slab of bedrock sample 12-MPB-1042 submitted for recovery of heavy minerals.

examined and described by S.A. Averill, a geologist at ODM (**Appendix A1**), and then disaggregated at ODM using a custom built CNT Spark-2 electric pulse disaggregator (EPD), instead of a conventional rock crusher, to preserve natural grain sizes, textures, and shapes. The sample was placed in a metal chamber that was then filled with water and sealed. Electric pulses were then applied to the sample. The rapid scattering of electric pulses through the sample leads to explosions, which occur preferentially along grain boundaries, the natural zones of weakness in a rock sample. The explosions along grain boundaries result in liberated individual, undamaged mineral grains that are recovered in their original shape and form regardless of grain size (Rudashevski et al., 2002; Lastra et al., 2003; Cabri et al., 2008). A quartz 'blank' bedrock sample was processed before the Little River bedrock sample to monitor cross contamination from previous rock samples. The use of quartz blanks is a routine procedure used by GSC to monitor the preparation of the heavy mineral fraction of bedrock samples (Plouffe et al., 2013). Blank samples are identified by the letters 'BLK' in their sample number. The results for two blanks are reported along with the bedrock samples in **Appendix A2.**

The <2 mm material (~57 g) of the bedrock sample was then processed at ODM to produce a non-ferromagnetic heavy mineral concentrate for picking indicator minerals, and weights for all fractions produced are reported in **Appendix A2**. The <2 mm concentrate was micro-panned to recover any antimonides, gold, sulphides, and other indicator minerals. The minerals in the panned concentrates were counted and their size and shape characteristics recorded and then returned to the sample. The heavy table concentrate was then sieved at 0.18 mm. The 0.18 to 2.0 mm pre-concentrate was then further refined using heavy liquid separation in methylene iodide diluted to a specific gravity (SG) of 3.2.

The ferromagnetic fraction was then separated using a hand magnet. The non-ferromagnetic heavy mineral fraction (HMC) was sieved into four size fractions: 0.18-0.25, 0.25-0.5, 0.5-1.0, 1.0-2.0 mm. The 0.18-0.25 mm fraction was archived and the 0.25-0.5 mm fraction was further subjected to paramagnetic separations using a Carpco® magnetic separator at 0.6, 0.8 and 1.0 amps to facilitate mineral identification in this fine size fraction based in part on the minerals' magnetic properties. The 0.25-0.5, 0.5-1.0, 1.0-2.0 mm non-ferromagnetic HMC (SG >3.2) were examined by trained personnel at ODM and indicator minerals were counted/selected, including atimonide minerals and gold. The visual identification of five grains was verified with a scanning electron microscope (SEM).

ODM produced a digital data file for the sample (**Appendix A2**) which consists of several worksheets. The weights of fractions generated during bedrock disaggregation and subsequent heavy liquid separation are listed in the worksheets: "EPD Weights"; "Processing Weights" (SG >3.2); and "Paramag" (weights for the paramagnetic and non-paramagnetic fractions). Gold grain data generated from panning the bedrock sample are reported in two worksheets: "Gold Summary" and "Detailed VG", which describe the abundance, size and shape of the visible antimonide, gold and sulphide grains observed during panning. Indicator minerals (0.25-2.0 mm in size) are listed in worksheet: "MMSIM" for the SG >3.2 fractions.

RESULTS

The pan concentrate of the <2 mm fraction of bedrock contained seven gold grains (25 to 100 µm in size), ~200,000 grains of stibnite (Sb_2S_3) (25-500 µm), ~50 grains of pyrite (25-200 µm) and three arsenopyrite grains (100-200 µm). The following indicator minerals were recovered from the 0.25-0.5 mm non-ferromagnetic HMC fraction of the bedrock sample: ~20,000 stibnite grains, five grains of stibiconite ($Sb_3O_6(OH)$), and a few grains of goethite. Coarser grains of stibnite were also recovered from the 0.5-1.0 mm and the 1.0-2.0 mm HMC fractions.

A colour photo of stibnite grains in the 0.25-0.5 mm fraction is shown in Figure 4. Stibnite was identified in HMC by is metallic grey colour and softness. It has a SG of 4.63 and a hardness of 2. It can look like molybdenite at first glance, but molybdenite would be quickly discounted when the stibnite is closely examined. In this sample, the stibnite is massive, and does not display the slender needle-like crystals often seen in textbooks. Stibiconite has a SG of 4.1-5.8, a hardness of 4-5, and a pale orange colour. It is an alteration mineral of stibnite and its identity in the bedrock sample HMC was confirmed using a scanning electron microscope.

Table 1. Size and abundance of stibnite grains recovered from bedrock sample 12-MPB-1042, listed as raw counts in the 0.57 g sample and counts normalized to a 1 kg sample weight.

	weight (kg)	stibnite pan concentrate	stibnite 0.25-0.5 mm	stibnite 0.5-1.0 mm	stibnite 1.0-2.0 mm
raw data	0.06	200,000	20,000	3,000	150
normalized	1.00	350,00,000	35,000,000	5,000,000	260,000

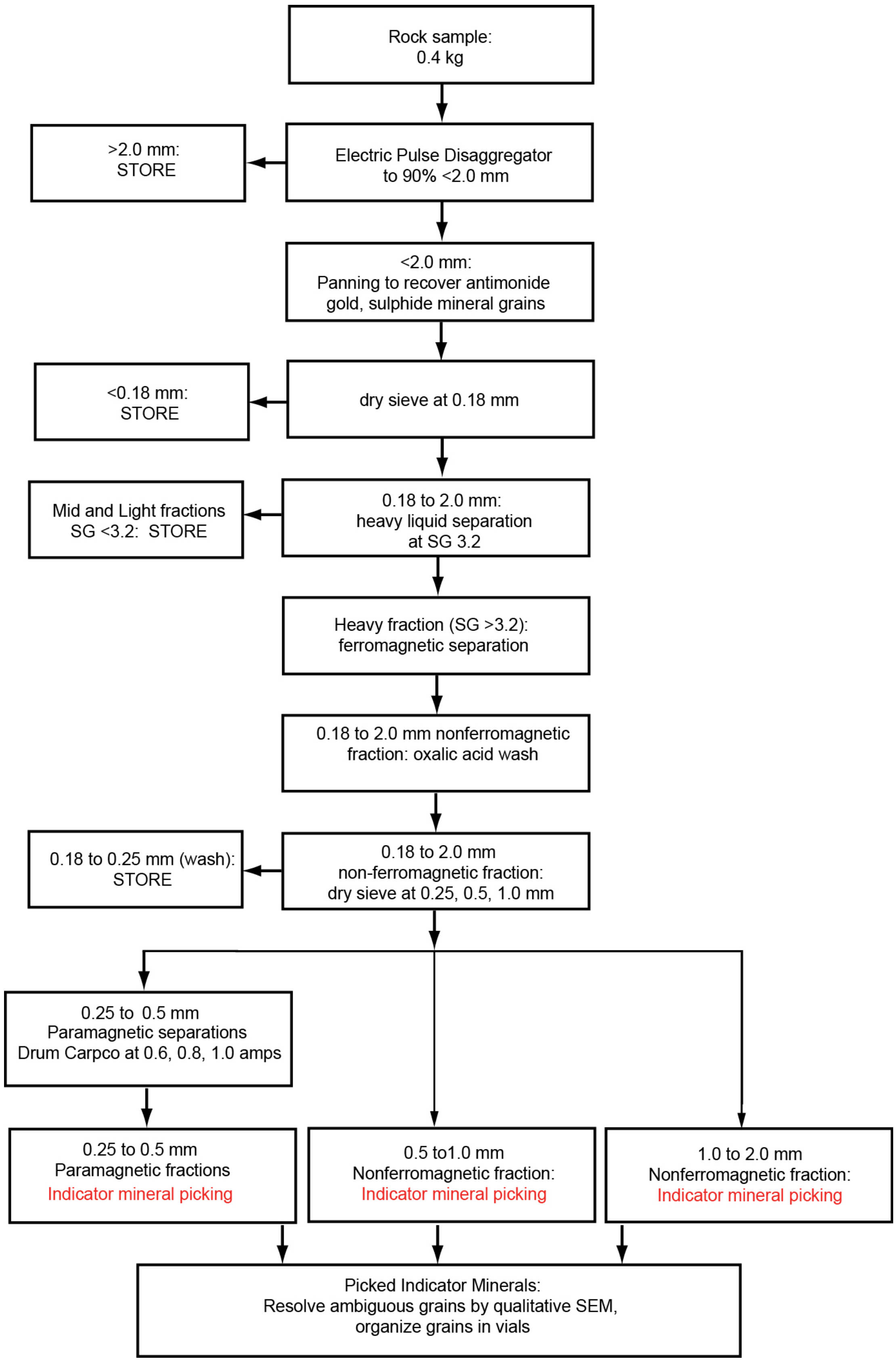

Figure 3. Flow sheet outlining the sample processing and picking procedures used to prepare bedrock sample 12-MPB-1042 at Overburden Drilling Management Limited.

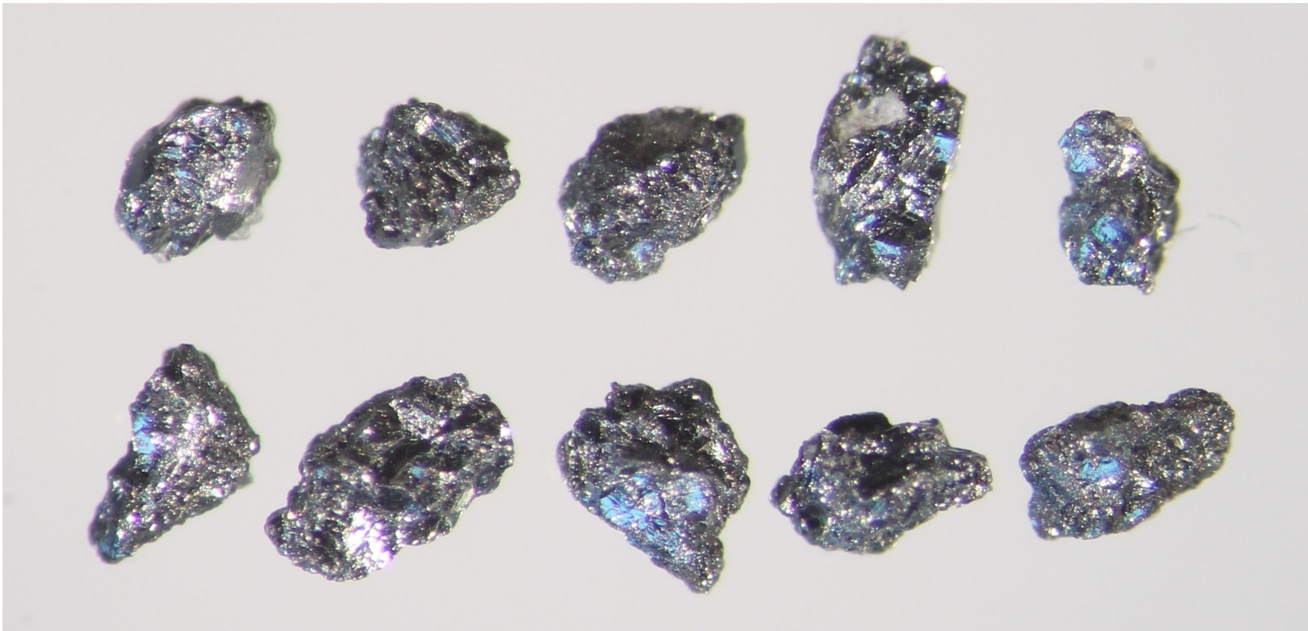

Figure 4. Colour photograph of stibnite grains from the 0.25-0.5 mm fraction of bedrock sample 12-MPB-1042. Largest grain is 0.5 mm.

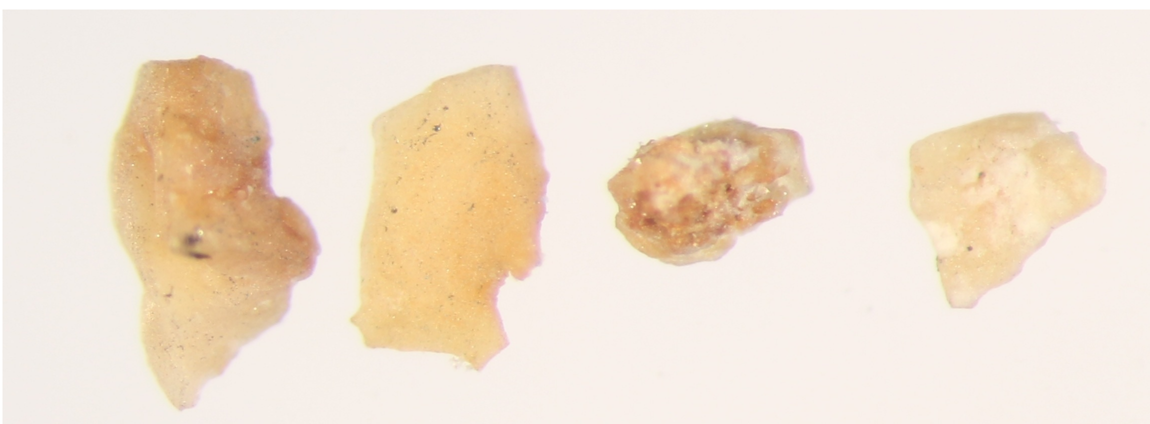

Figure 5. Colour photograph of stibiconite grains from the 0.25-0.5 mm fraction of bedrock sample 12-MPB-1042. Largest grain is 0.5 mm.

CONCLUSIONS

Two antimony minerals were recovered from the bedrock sample, stibnite and stibiconite. Additional indicator minerals recovered include gold, arsenopyrite, and pyrite. This focused study has provided some preliminary insights into the physical appearance, size, and abundance of Sb-rich minerals. These insights may be helpful to commercial heavy mineral processing laboratories in the recognition and documentation of Sb-rich indicator minerals in surficial sediment samples.

ACKNOWLEDGMENTS
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Appendix A1: Bedrock binocular microscope hand sample description by Overburden Drilling Management Ltd.

by S.A. Averill

12-MPB-1042   SULPHIDE VEIN. 8 cm hand specimen.
Brecciated white quartz vein cemented with 60% stibnite occurring as masses of 0.5-2 mm, soft, platy, sectile, variably striated, fresh silver-grey stibnite crystals. No other sulphides or gangue minerals.